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Clamping chuck and key rod therefor

5 The present invention concerns a powered clamping chuck for machine tools, in particular for lathes, having a chuck body and several clamping jaws that are arranged movably in radial jaw guides of the chuck body and are displaceable together, by  
10 means of a drive, radially with respect to the chuck axis, the drive including key bars that are slidably guided transversely to the chuck axis for displacement of the clamping jaws in the chuck body and each comprise a tooth set that is in engagement with a corresponding counter-tooth set on an associated clamping jaw; a positioning mechanism being provided that comprises a releasing bolt mounted rotatably in the  
15 chuck body and a releasing key that can be coupled to the releasing bolt in order to displace, by way of a rotation of the releasing bolt, the key bar or a coupling attachment, comprising the tooth set, of the key bar parallel to the chuck axis between an upper working position and a lower jaw changing position in which the tooth set of the key bar is pulled back out of the counter-tooth set of the clamping jaw and the latter  
20 can be removed radially from the chuck body; and a locking device being provided which locks the releasing key on the releasing bolt and permits disengagement of the releasing key only in the working position of the key bar. The invention further concerns a key bar for such a clamping chuck.

25 Clamping chucks of this kind for machine tools are known, and in practice are used principally on lathes in order to clamp the workpieces to be machined. Conventional clamping chucks comprise a dimensionally stable chuck body that has a central receiving opening for the workpieces, as well as several clamping jaws that are radially movable in jaw guides of the chuck body. In addition to manually actuatable manual  
30 clamping chucks, so-called powered clamping chucks, in which the clamping forces exerted by the clamping jaws on the workpiece are generated in motorized or hydraulic fashion, are often used in more complex machine tools, especially in program-controlled automatic lathes.

35 DE-A-43 35 896, for example, discloses a powered clamping chuck that operates on the principle of key bars that move in a straight line and are guided movably in key bar pockets provided transversely to the guide grooves for the clamping jaws. The key bars, which are driven by a cylinder arranged in the chuck body, are coupled to the clamping

5 jaws via oblique tooth sets in such a way that the tangential motions of the key bars in the key bar pockets are converted into radial clamping motions of the clamping jaws.

With the known clamping chuck, each key bar can be axially displaced by way of an eccentric positioning member (eccentric bolt) that engages into the key bar and is  
10 rotatable from outside by means of a releasing key, so that the bar's tooth set comes out of engagement with the counter-tooth set of the associated clamping jaw, and the clamping jaw can be pulled radially out of the guide groove in the chuck body.

In another powered clamping chuck that is known from DE 40 16 775 C1, the key bars  
15 are held in axially displaceable fashion in a driving jaw displaceable radially with respect to the chuck axis. In this clamping chuck, the driving jaw is radially displaceable via a wedge hook coupling by means of an axially movable chuck piston in order to move the driving jaw together with the key bar, and the key bar can be moved parallel to the chuck axis with respect to the driving jaw in order to bring the latter out of engagement  
20 with the clamping jaw, so that the clamping jaw can be pulled out of the guide groove in the chuck body.

With the known powered clamping chucks, actuation of the eccentric bolts is accomplished via a releasing key that must be withdrawn again from the chuck body  
25 before the powered clamping chuck is put into service. For operating safety reasons, the known powered clamping chucks have a locking device which permits such withdrawal only when the eccentric bolt is in its operating position that corresponds to the working position of the key bar, but otherwise prevents withdrawal of the releasing key. This is intended to give the user a visual notification, by way of the releasing key  
30 inserted into the chuck body, that the powered clamping chuck is not yet in the operating state.

It is the object of the invention to develop a powered clamping chuck of the kind cited initially, and a key bar, in such a way that operating safety can be considerably  
35 enhanced.

This object is achieved, according to the present invention, in that the key bar has locking means that allow a rotation of the releasing bolt out of the rotational position.

5 corresponding to the lower jaw changing position of the key bar, into the rotational position corresponding to the upper working position of the key bar, if the tooth set of the coupling attachment is in engagement with the counter-tooth set of an associated clamping jaw, and that otherwise prevent rotation of the releasing bolt into the rotational position corresponding to the upper working position.

10 The invention is thus based on the idea of configuring powered clamping chucks in such a way that the eccentric bolt can be returned back to its starting position, in which the releasing key can be withdrawn, only when it is guaranteed that a clamping jaw is inserted into the corresponding jaw guide of the chuck body, and in particular that an  
15 overlap that is sufficient in terms of safety exists between the tooth sets of the clamping jaw and the key bar.

According to an embodiment of the invention, provision is made for the key bars each to have a key bar body and, held thereon, a coupling attachment on which the tooth set  
20 is provided, an eccentric bolt coupled to the releasing bolt being rotatably mounted in a transverse bore of the key bar body and carrying a radially projecting extension that, upon a rotation of the eccentric bolt, comes into engagement with a corresponding countersurface of the coupling attachment in order to displace the coupling attachment between the upper working position and the lower jaw changing position.

25 In an implementation of this embodiment of the invention, provision is made that the locking means include a snap-lock pin that is held slidably in a passthrough bore which extends, parallel to the direction of motion of the coupling attachment, from the tooth set of the coupling attachment through the coupling attachment and the key bar body to  
30 the transverse bore in which the eccentric bolt is arranged; and the locking means furthermore comprise a pusher element that is arranged slidably in a bore of the eccentric bolt and is pushed outward by a compression spring element braced in the bore, the bore of the eccentric bolt and the passthrough bore in which the snap-lock pin is held being located opposite one another in a predefined rotational position of the  
35 eccentric bolt, so that the pusher element is pushed by the preload force of the compression spring element into the passthrough bore and pushes the snap-lock pin out of the coupling attachment; a rotation of the eccentric bolt back into the starting position, and thus a return of the coupling attachment to its working position, then being

5 prevented by the engagement of the pusher element into the passthrough bore; and the snap-lock pin being prevented from emerging from the key bar by the counter-tooth set of a clamping jaw that is mounted on the key bar and closes off the passthrough bore, so that the pusher element remains outside the passthrough bore and the eccentric bolt can be rotated back into its starting position.

10 In this embodiment, the coupling attachment is locked in the jaw changing position, and the eccentric bolt in its rotational position corresponding to the jaw changing position, if the pusher element that is held in the eccentric bolt engages into the passthrough bore in which the snap-lock pin sits. Engagement of the pusher element in this fashion is possible only if the upper end of the passthrough bore, which is positioned in the region of the tooth set of the key bar, is clear and the snap-lock pin can emerge from the key bar, i.e. if emergence is not prevented by a clamping jaw inserted into the corresponding jaw guide. If, on the other hand, such emergence of the snap-lock pin from the key bar is prevented by a clamping jaw, thus ensuring on the one hand that a clamping jaw is in fact inserted into the clamping jaw and on the other hand that the clamping jaw is also inserted sufficiently far into the jaw guide and the safety-relevant overlap of the tooth sets of the key bar and clamping jaw thus exists, the snap-lock pin prevents the pusher element of the eccentric bolt from entering the passthrough bore and thus ensures that the eccentric bolt can be rotated back into the starting position.

25 In a further implementation of this embodiment, provision is usefully made for the pusher element to be of beveled or rounded configuration in the region of its end surface that comes into contact with the snap-lock pin. This ensures that even in those cases in which the pusher element engages undesirably loosely into the passthrough hole, for example because of production tolerances, the beveled or rounded end surface acts as a runout bevel that coacts with an edge of the passthrough hole in order to slide the pusher element back into the eccentric bolt when the eccentric bolt is rotated back into its starting position.

35 In a further embodiment of the invention, the key bar extension can possess on its underside a guide extension that engages into a corresponding guide bore of the key bar body. The coupling attachment is preferably braced against the key bar body by way of compression springs and is pushed toward the clamping jaw. In this case

5 provision is made, according to a preferred embodiment, for the countersurface of the key bar with which the extension of the eccentric bolt comes into engagement to be embodied on the guide extension.

10 Regarding further advantageous embodiments of the invention, the reader is referred to the dependent claims and to the description below of an exemplary embodiment making reference to the appended drawings. In the drawings:

- 15 FIG. 1 is a perspective depiction of an embodiment of a clamping chuck according to the present invention;
- FIG. 2 is a plan view of the clamping chuck of FIG. 1;
- FIG. 3 shows the clamping chuck in section along line F-F in FIG. 2;
- 20 FIG. 4 is a side view of the clamping chuck of FIG. 2, with a partial section along line A-A in FIG. 2;
- FIG. 5 is a perspective view of a key bar according to the present invention;
- 25 FIG. 6 shows the key bar, in section along line VII-VII in FIG. 5, in the working position;
- FIG. 7 shows the key bar of FIG. 6 after the eccentric bolt has been rotated 82° clockwise;
- 30 FIG. 8 shows the key bar of FIG. 7 after the eccentric bolt has been rotated 90° clockwise;
- FIG. 9 shows the key bar of FIG. 7 after the eccentric bolt has been rotated through the maximum travel of 97°; and
- 35 FIG. 10 shows the key bar of FIG. 7 after the eccentric bolt has been rotated 90° clockwise, but without the clamping jaw.

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FIGS. 1 through 5 depict an embodiment of a clamping chuck in accordance with the present invention that can be used, for example, to clamp workpieces in lathes. The clamping chuck includes a chuck body 1 of basically cylindrical shape that can be secured at its rear end surface to the spindle (not depicted) of a machine tool. The clamping chuck comprises a central opening 2 into which can be inserted a workpiece to be clamped.

The clamping chuck depicted is embodied in conventional fashion as a three-jaw chuck. Three radial jaw guides 3, which are distributed uniformly over the circumference (i.e. are arranged with an offset of 120° from one another), are correspondingly provided on the front end face of chuck body 1. Inserted into jaw guides 3 are clamping jaws 4 that can each comprise a base jaw and an attachable jaw that can be bolted thereonto. Only the respective base jaws of clamping jaws 4 are depicted in the drawings. The three clamping jaws 4 can be displaced inward and outward together by way of a key bar mechanism in order to clamp and release workpieces.

This key bar mechanism includes three key bars 5 that are each associated with one of the clamping jaws 4 and are held in chuck body 1 displaceably perpendicular to jaw guides 3. Concretely, key bars 5 each comprise an elongated key bar body 5a that is arranged displaceably in chuck body 1 and is equipped at its one end, located radially farther inward, with wedge surfaces 6 that extend obliquely with respect to chuck axis A and coact with corresponding wedge surfaces of a chuck piston K (merely indicated) in order to convert an axial motion of chuck piston K in chuck body 1 into a radial motion of key bar bodies 5a. Key bars 5 furthermore each have a coupling attachment 5b that carries on its front side a tooth set 7 which engages into a corresponding counter-tooth set 8 on the associated clamping jaw 4. In the Figures, key bar 5 and clamping jaw 4 are depicted in their coupled position. The decoupled position is not shown.

In the embodiment depicted, coupling attachments 5b are substantially plate-shaped and are inserted into a corresponding recess 9 on the upper side of the respective key bar body 5. Coupling attachment 5b engages, with two ear-shaped extensions 10 on its axial ends, into complementarily configured regions of recess 9 to form a positive engagement, so that coupling attachment 5b is at least substantially immovable with

5 respect to key bar body 5a transversely to chuck axis direction A, and so that forces acting transversely to the chuck axis direction are directed via ear-shaped extensions 10 into key bar body 5a. This bracing of coupling attachment 5b on key bar body 5a prevents any tilting of coupling attachment 5b.

10 In chuck axis direction A, key bar attachments 5b are movable with respect to key bar bodies 5a between an upper working position and a lower jaw changing position. For that purpose, each coupling attachment 5b has on its underside a bolt-shaped guide extension 11 that engages into a corresponding guide bore 17 of key bar body 5a. It is

15 5b is braced against key bar body 5a by way of two compression springs 15 that are arranged in key bar body 5a and that push coupling attachment 5b, via corresponding pusher pieces 16, toward clamping jaw 4 into the working position.

To allow coupling attachment 5b to be displaced out of the working or coupled position depicted in FIG. 3, in which its tooth set 7 is in engagement with counter-tooth set 8 of clamping jaw 4, into the lower jaw changing position, a positioning member is provided in the form of an eccentric bolt 12 that is mounted rotatably in a transverse bore 13 of key bar body 5a and carries, as an eccentric, an extension in the form of a pin 14 protruding radially from bolt 12. This pin 14 engages into a recess 18 of guide bolt 11 of

20 coupling attachment 5b, and after a rotation of eccentric bolt 12 approximately 80° counterclockwise out of the position shown in FIG. 3, comes into engagement with a countersurface 19 of guide bolt 11, so that upon a further rotation, coupling attachment 5b is pushed downward until tooth set 7 of key bar 5 is pulled completely out of counter-

25 tooth set 8 of clamping jaw 4, and clamping jaw 4 can be pulled in the radial direction out of jaw guide 3 in chuck body 1.

To allow eccentric bolt 12 to be rotated, it is connected to a releasing bolt P that is equipped on its external end surface with a key surface 20 into which the coupling element of releasing key S, here in the form of a hex head 28, can be inserted (see

35 FIG. 2).

As already explained previously, coupling attachment 5b is braced by the two compression springs 15 with respect to key bar body 5a, and is pushed upward toward

5 clamping jaw 4. The consequences of this are on the one hand that the spring force of  
compression springs 15 must be overcome in order to disengage coupling attachment  
5b from its engagement with clamping jaw 4 by way of a rotation of eccentric bolt 12,  
but on the other hand that by way of the return force of compression springs 15,  
coupling attachment 5b is also automatically raised again, with a rotation of eccentric  
10 bolt 12, when an operator lets go of the rotating tool. The arrangement is such that  
compression springs 15 rotate eccentric bolt 12 not completely back into the starting  
position, but only sufficiently far that an overlap, but not complete engagement, of tooth  
sets 7, 8 takes place. This ensures that clamping jaw 4 can be pulled out of jaw guide 3  
only as long as the operator is holding the rotating tool in place, i.e. the jaw change is in  
15 all cases intentional.

For safety reasons, provision is made according to the present invention that releasing  
key S for actuating eccentric bolt 12 can be pulled out of chuck body 1 only if eccentric  
bolt 12 is in its starting position (operating position) which corresponds to the upper  
20 working position of key bar 5.

Provided for this purpose is a locking device that is known per se and is depicted in  
FIG. 2. This locking device encompasses a ball 29 that is arranged at a transverse bore  
30 of releasing bolt P; in its starting position as depicted in FIG. 2, it can escape radially  
25 outward into a recess 31 of jaw body 1, but in other rotational positions it is prevented  
by chuck body 1 from thus escaping, and is pushed radially inward into key surface 20  
of releasing bolt P, where it comes into engagement with a peripheral groove 32 of the  
inserted releasing key 21 in order to immobilize the latter on chuck body 1.

30 Additionally provided, according to the present invention, are locking means intended to  
prevent eccentric bolt 12 from being brought into its starting or operating position if a  
clamping jaw 4 is not inserted in prescribed fashion into the corresponding jaw guide 3  
of chuck body 1.

35 These locking means will be explained below with reference to FIGS. 6 through 10,  
which show a key bar 5 in accordance with the present invention. According thereto, the  
locking means encompass firstly a snap-lock pin 21 that is held displaceably in a  
passthrough bore 22 that extends, parallel to the direction of motion of coupling



5 attachment 5b, from tooth set 7 of coupling attachment 5b downward through coupling  
attachment 5b and key bar body 5a to transverse bore 13 in which eccentric bolt 12 is  
arranged. Snap-lock pin 21 can emerge upward out of passthrough bore 22 into the  
region of tooth sets 7, an upper final position being defined by corresponding axial stop  
10 surfaces on snap-lock pin 14 and on passthrough bore 22. The diameters of pusher  
element 23 and of passthrough bore 22 are correspondingly coordinated with one  
another. Also part of the locking means is a pusher element 23 which is arranged  
slidably in a bore 24 of eccentric bolt 12 and by means of which a compression spring  
element 25, braced in bore 24, is pushed outward.

15 The positions of bore 24 in eccentric bolt 12 and of passthrough bore 22 for snap-lock  
pin 14 are coordinated with one another so that in a predefined rotational position of  
eccentric bolt 12 -- i.e., in the embodiment depicted, in the position depicted in FIG. 8,  
in which eccentric bolt 12 is rotated 90° clockwise with respect to the starting position  
20 depicted in FIG. 7 -- bores 22, 24 are located opposite one another and are aligned  
coaxially with one another, and pusher element 23 can be pushed into passthrough  
bore 22 by the spring force of compression spring element 25.

As is evident from a comparison of FIGS. 8 and 10, an entry of pusher element 23 into  
passthrough bore 22 is possible only if snap-lock pin 21 can emerge upward out of  
25 coupling attachment 5b. This is the case only if the opening of passthrough bore 22 is  
clear in the region of tooth set 7, as shown in FIG. 10, and is not closed off by a  
clamping jaw 4, as shown in FIG. 10. In other words, pusher element 23 cannot enter  
passthrough bore 22 if a clamping jaw is correctly inserted into the corresponding jaw  
guide 3. Entry is thus possible only if a clamping jaw 4 is not inserted, or is not inserted  
30 far enough that it covers passthrough bore 22, i.e. if an incorrect operating state exists.  
In this case the engagement of pusher element 23 into passthrough bore 22 prevents  
eccentric bolt 13 from being rotated back into its starting position. What occurs  
concretely is contact of pusher element 23 against the wall of passthrough bore 22 at  
point Z shown in FIG. 10.

35 The operation of changing a clamping jaw 4 will be explained below with reference to  
FIGS. 6 through 10.

5 FIG. 6 shows the starting or operating position, in which coupling attachment 5b of key bar 5 is in its upper working position and is in engagement with a clamping jaw 4 that is inserted into the corresponding jaw guide 3 of clamping chuck 1.

10 In order to change clamping jaw 4, eccentric bolt 13 is rotated approximately  $97^\circ$ , by means of a releasing key S, out of the starting position depicted in FIG. 6 into the final position depicted in FIG. 9. As already described, after a rotation angle of approximately  $80^\circ$  a first contact takes place between pin 14 and the corresponding countersurface 19 of guide bolt 11, in such a way that upon further rotation, coupling attachment 5 is pushed downward until tooth set 7 of key bars 5 is pulled completely  
15 out of counter-tooth set 8 of clamping jaw 4.

In the context of this rotation, at a rotation angle of approximately  $82^\circ$  pusher element 23 comes into contact with snap-lock pin 21, as indicated in FIG. 7. Upon a further rotation into the position shown in FIG. 8 ( $90^\circ$ ), snap-lock pin 21 is pushed upward by  
20 the force of compression spring element 25, although clamping jaw 4 prevents snap-lock pin 21 from being able to emerge upward out of coupling attachment 5b. When eccentric bolt 12 is rotated further into the final position depicted in FIG. 12, coupling attachment 5b moves farther downward relative to coupling attachment 5b until tooth sets 7, 8 have separated. In this final position, clamping jaw 4 can be pulled out of the  
25 corresponding jaw guide 3 in chuck body 1, and a new one inserted. When a new clamping jaw 4 is inserted, eccentric bolt 13 can be rotated back into its starting position in a reversal of the procedure previously described.

If, as depicted in FIG. 10, there is no clamping jaw 4 inserted, eccentric bolt 13 can be  
30 rotated back only as far as the position depicted in FIG. 10, in which pusher element 23 and passthrough bore 22 are located opposite one another. In this position, pusher element 23 is pushed upward into passthrough bore 22 by the return force of compression spring element 25, snap-lock pin 21 being pushed upward out of coupling attachment 5b. In this position, the engagement between pusher element 23 and  
35 passthrough bore 22 at point Z prevents any further backward rotation of eccentric bolt 23.